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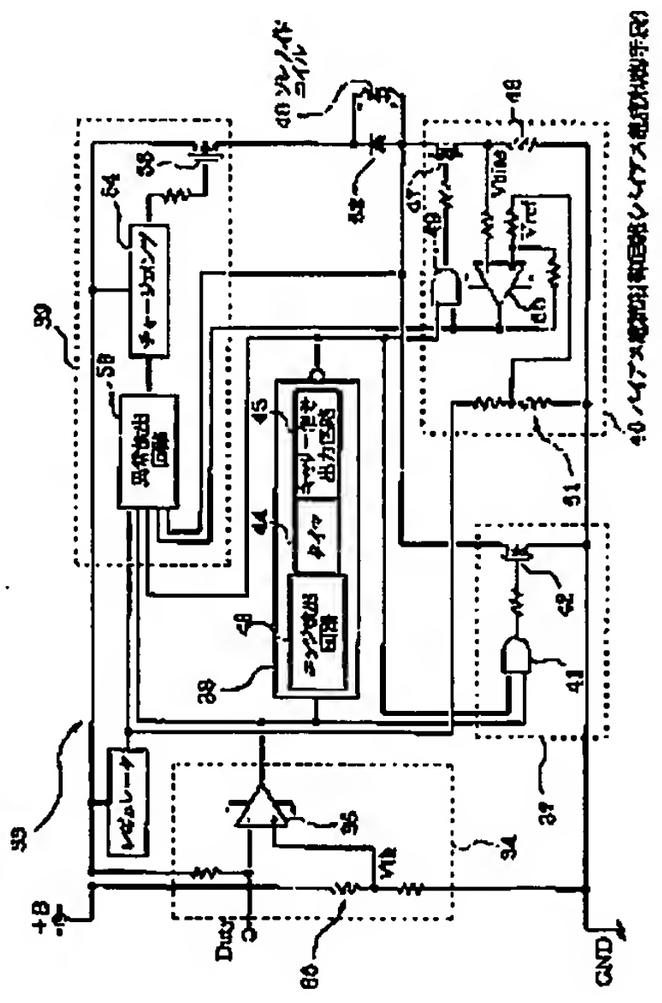
最終頁に続く

(54)【発明の名称】　電磁弁制御装置

(57)【要約】
【課題】　高速弁の開弁制御特性向上と低コスト化とを両立させる。
【解決手段】　バイアス電流制御回路４６は、パージ制御弁（高速弁）のソレノイドコイル４０に一定のバイアス電流を流す回路であり、バイアス電流を制御するＭＯＳＦＥＴ等のスイッチング素子４７と電流検出抵抗４８との直列回路をデューティ制御用のスイッチング素子４２と並列に設ける。バイアス高速制御回路４６は、ソレノイドコイル４０に流れるバイアス電流を高速検出抵抗４８で検出し、スイッチング素子４７のスイッチングを制御してバイアス高速を目標値に制御する。ここで、バイアス高速の目標値は、バイアス高速によるパージ制御弁の開弁方向の電磁力が閉弁時のばねによる閉弁力をほぼキャンセルするように設定する。このようにすれば、高速電圧の変動やコイル温度の変化があっても、パージ制御弁の開弁タイミングのずれをほぼ無くすことができる。



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【特許請求の範囲】
【請求項１】　電磁弁の弁体をばねによって閉弁方向へ付勢し、該電磁弁のソレノイドコイルに電流を流すことで、前記弁体を前記ばねに抗して開弁方向に駆動して電磁弁の開度を制御する電磁弁制御装置において、
前記ソレノイドコイルに所定のバイアス電流を流すバイアス電流制御手段を備えていることを特徴とする電磁弁制御装置。
【請求項２】　前記バイアス電流制御手段は、前記バイアス電流による開弁方向の電磁力が閉弁時の前記ばねによる閉弁力をほぼキャンセルするように前記バイアス電流を設定することを特徴とする請求項１に記載の電磁弁制御装置。
【請求項３】　前記バイアス電流制御手段は、前記電磁弁の開弁状態が所定時間以上継続した時に前記バイアス電流をオフすることを特徴とする請求項１又は２に記載の電磁弁制御装置。
【請求項４】　前記電磁弁は、燃料タンク内から生じた燃料蒸発ガスを内燃機関の吸気管にパージするパージ経路の途中にパージ制御弁として設けられていることを特徴とする請求項１乃至３のいずれかに記載の電磁弁制御装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、電磁弁の開弁特性を改善した電磁弁制御装置に関するものである。
【０００２】
【従来の技術】従来より、電磁弁は、種々の流体の流れを制御する手段として多用されており、例えば、自動車では、燃料蒸発ガスパージシステムのパージ制御弁やアイドルスピードコントロールバルブ（ＩＳＣＶ）等として電磁弁が用いられている。ここで、燃料蒸発ガスパージシステムは、燃料タンク内の燃料が蒸発して生じた燃料蒸発ガス（エバポガス）を内燃機関の吸気管にパージするパージ経路の途中に、燃料蒸発ガスを吸着するキャニスタとパージ制御弁とを設け、このパージ制御弁を制御することで、キャニスタから吸気管にパージする燃料蒸発ガスのパージ量を制御するものである。
【０００３】現在、使用されているパージ制御弁は、電磁弁を用いた電磁駆動式の他、吸気管負圧を圧力源とするニューマチックバルブを用いた負圧駆動式（特開昭６２－１５３５５３号公報参照）があるが、負圧駆動式では、吸気管負圧を導入する配管を設ける必要があるため、コスト高になる欠点がある。
【０００４】一方、電磁駆動式のパージ制御弁（特開平１０－９００９号公報参照）は、パージ制御弁の開弁時間（オン時間）と閉弁時間（オフ時間）との比率を制御することで、燃料蒸発ガスのパージ量を制御するようになっている。しかし、パージ制御弁の開弁／閉弁（パージ実行／停止）を頻繁に繰り返すと、キャニスタから吸気管に流れ込む燃料蒸発ガスパージ量が脈動するため、内燃機関の気筒内に吸入される混合気の空燃比が乱れて、エミッションやドライバビリティが悪化してしまう。これを改善するために、リニアソレノイドを駆動源とするパージ制御弁を用い、リニアソレノイドへの印加電圧をデューティ制御することで、パージ制御弁の開度を制御して、燃料蒸発ガスのパージ量を制御するようにしたものがある。
【０００５】
【発明が解決しようとする課題】ところで、パージ制御弁（電磁弁）には、弁体を閉弁方向へ付勢するばねが内蔵され、このばね力によって閉弁状態が維持されるようになっているため、開弁するには、少なくとも、ばねによる閉弁力に打ち勝つだけの電磁力（開弁力）をソレノイドで発生する必要がある。
【０００６】車両運転中は、電源電圧が変動したり、コイル温度の変化によりコイル抵抗値が変化するため、ソレノイドへの印加電圧をデューティ制御する方式では、図４（ｂ）に示すように、電源電圧の変動やコイル温度の変化によりソレノイドコイルに流れる電流値が変化してソレノイドの電磁力が大きく変化してしまい、パージ制御弁が閉弁状態から実際に開弁し始める時のデューティ信号ＤＵＴＹが大きく変化してしまう。
【０００７】パージ制御弁の開弁直後に燃料蒸発ガスのパージ量が急増して空燃比を急変させるため、パージ制御弁の開弁と同時に空燃比をパージ量に応じて補正することが好ましいが、従来のデューティ制御方式では、図４（ｂ）に示すように、電源電圧の変動やコイル温度の変化によりパージ制御弁の開弁タイミングが大きくずれてしまうため、エンジン制御回路には実際のパージ制御弁の開弁タイミングが分からず、パージ制御弁の開弁による空燃比の急変を精度良く補正することはできない。
【０００８】この不具合を解消するため、近年、ソレノイドコイルに流す電流をフィードバック制御することで、電源電圧の変動やコイル温度の変化の影響を受けないように電磁力（コイル電流値）を制御する電流制御方式のパージ制御弁を採用したものがある。しかし、この電流制御方式では、全領域でコイル電流をフィードバック制御する必要があるため、制御回路の構成が複雑化してコストアップする欠点がある。
【０００９】本発明はこのような事情を考慮してなされたものであり、従ってその目的は、電磁弁の開弁制御特性向上と低コスト化とを両立させることができる電磁弁制御装置を提供することにある。
【００１０】
【課題を解決するための手段】上記目的を達成するために、本発明の請求項１の電磁弁制御装置は、バイアス電流制御手段によりソレノイドコイルに所定のバイアス電流を流すことで、ばねによる閉弁力に対抗する開弁方向の電磁力を発生させる。このバイアス電流による開弁方

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2

気管に流れ込む燃料蒸発ガスパージ量が脈動するため、内燃機関の気筒内に吸入される混合気の空燃比が乱れて、エミッションやドライバビリティが悪化してしまう。これを改善するために、リニアソレノイドを駆動源とするパージ制御弁を用い、リニアソレノイドへの印加電圧をデューティ制御することで、パージ制御弁の開度を制御して、燃料蒸発ガスのパージ量を制御するようにしたものがある。
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【０００６】車両運転中は、電源電圧が変動したり、コイル温度の変化によりコイル抵抗値が変化するため、ソレノイドへの印加電圧をデューティ制御する方式では、図４（ｂ）に示すように、電源電圧の変動やコイル温度の変化によりソレノイドコイルに流れる電流値が変化してソレノイドの電磁力が大きく変化してしまい、パージ制御弁が閉弁状態から実際に開弁し始める時のデューティ信号ＤＵＴＹが大きく変化してしまう。
【０００７】パージ制御弁の開弁直後に燃料蒸発ガスのパージ量が急増して空燃比を急変させるため、パージ制御弁の開弁と同時に空燃比をパージ量に応じて補正することが好ましいが、従来のデューティ制御方式では、図４（ｂ）に示すように、電源電圧の変動やコイル温度の変化によりパージ制御弁の開弁タイミングが大きくずれてしまうため、エンジン制御回路には実際のパージ制御弁の開弁タイミングが分からず、パージ制御弁の開弁による空燃比の急変を精度良く補正することはできない。
【０００８】この不具合を解消するため、近年、ソレノイドコイルに流す電流をフィードバック制御することで、電源電圧の変動やコイル温度の変化の影響を受けないように電磁力（コイル電流値）を制御する電流制御方式のパージ制御弁を採用したものがある。しかし、この電流制御方式では、全領域でコイル電流をフィードバック制御する必要があるため、制御回路の構成が複雑化してコストアップする欠点がある。
【０００９】本発明はこのような事情を考慮してなされたものであり、従ってその目的は、電磁弁の開弁制御特性向上と低コスト化とを両立させることができる電磁弁制御装置を提供することにある。
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向の電磁力がばねによる閉弁力に近付くほど、電磁弁の開弁タイミングのずれが少なくなる（図４参照）。従って、バイアス電流を流しながらデューティ制御を行えば、従来のデューティ制御よりも電磁弁の開度を精度良く制御できる。しかも、電流制御方式とは異なり、全領域でコイル電流をフィードバック制御する必要がなく、簡単な回路構成を採用することができる。

【００１１】この場合、請求項２のように、バイアス電流による開弁方向の電磁力が開弁時のばねによる閉弁力をほぼキャンセルするようにバイアス電流を設定することが好ましい。このようにすれば、電源電圧の変動やコイル温度の変化があっても、電磁弁の開弁タイミングのずれをほぼ無くすことができる。

【００１２】また、請求項３のように、電磁弁の閉弁状態が所定時間以上継続した時にバイアス電流をオフするようにしても良い。つまり、電磁弁の閉弁状態が長く続く時には、バイアス電流を流す必要がないため、バイアス電流をオフすれば、電磁弁の開弁中のバイアス電流による消費電力増加やコイル温度上昇を回避できると共に、ばねによる閉弁力を確実に働かせて電磁弁を閉弁状態に確実に保持することができる。

【００１３】以上説明した本発明の電磁弁制御装置は、種々の流体の流れを電磁弁で制御するシステムに適用可能であるが、特に、請求項４のように、燃料蒸発ガスパージシステムに適用すれば、大きな効果が得られる。つまり、パージ制御弁の開弁直後に燃料蒸発ガスのパージ量が急増して空燃比を急変させるため、パージ制御弁の開弁と同時に空燃比をパージ量に応じて補正することが好ましい。本発明の電磁弁制御装置は、従来のデューティ制御方式と比較して、開弁タイミングのずれが少ない（又はゼロ）であるため、パージ制御弁の開弁による空燃比の急変を精度良く補正することが可能となり、パージ制御時のエミッションやドライバビリティを改善することができる。

【００１４】

【発明の実施の形態】以下、本発明を燃料蒸発ガスパージシステムに適用した一実施形態を図面に基づいて説明する。まず、図３に基づいてシステム全体の概略構成を説明する。エンジン１１の吸気管１２の上流側にはエアクリーナ１３が設けられ、このエアクリーナ１３を通過した空気がスロットルバルブ１４を通してエンジン１１の各気筒に吸入される。また、吸気管１２の各気筒の吸気ポートには燃料噴射弁１６が設けられ、各燃料噴射弁１６には、燃料タンク１７内の燃料（ガソリン）が燃料ポンプ１８により燃料配管１９を介して送られてくる。

【００１５】次に、燃料蒸発ガスパージシステム２１の構成を説明する。燃料タンク１７には、連通管２２を介してキャニスタ２３が接続され、このキャニスタ２３内に収容された活性炭等の吸着体２４によって燃料蒸発ガスが吸着される。このキャニスタ２３の底面部には、大気に連通する大気連通管２５が設けられ、この大気連通管２５にキャニスタ閉塞弁２６が取り付けられている。このキャニスタ閉塞弁２６は、常閉型の電磁弁により構成され、パージ制御中は、オフ状態（開弁状態）に維持され、キャニスタ２３内が大気に開放された状態に保持される。

【００１６】一方、キャニスタ２３と吸気管１２との間には、吸着体２４に吸着された燃料蒸発ガスを吸気管１２にパージ（放出）するためのパージ通路３０ａ、３０ｂが設けられ、このパージ通路３０ａ、３０ｂ間に、パージ流量を調整するパージ制御弁３１が設けられている。このパージ制御弁３１は、常閉型の電磁弁により構成され、オフ時には、内蔵したばね（図示せず）によって閉弁状態に保持される。このパージ制御弁３１は、エンジン制御回路３２内に設けられたマイクロコンピュータ（図示せず）とパージ制御回路３３（図１参照）とによって制御される。エンジン制御回路３２内のマイクロコンピュータは、エンジン運転状態に応じてパージ制御弁３１の目標開度（目標パージ率）を演算し、その目標開度に応じたデューティ信号Ｄｕｔｙをパージ制御回路３３に出力する。

【００１７】次に、図１に基づいてパージ制御回路３３の構成を説明する。パージ制御回路３３の入力インターフェース回路３４には、コンパレータ３５が内蔵されている。このコンパレータ３５の－入力端子には、エンジン制御回路３２内のマイクロコンピュータから出力されるデューティ信号Ｄｕｔｙが入力され、該コンパレータ３５の＋入力端子には、分圧回路３６の抵抗比で分圧された基準電圧Ｖｔｈが入力される。コンパレータ３５は、デューティ信号Ｄｕｔｙと基準電圧Ｖｔｈとを比較し、図２に示すようにデューティ信号Ｄｕｔｙがハイレベル（Ｄｕｔｙ＞Ｖｔｈ）の時に、該コンパレータ３５の出力がローレベルとなり、デューティ信号Ｄｕｔｙがローレベル（Ｄｕｔｙ＜Ｖｔｈ）の時に、該コンパレータ３５の出力がハイレベルとなる。

【００１８】このコンパレータ３５の出力（デューティ信号Ｄｕｔｙを反転した信号）は、デューティ制御回路３７、バイアス電流オン／オフ回路３８及びフェールセーフ回路３９にそれぞれ入力される。デューティ制御回路３７は、パージ制御弁３１のソレノイドコイル４０への通電をデューティ制御する回路であり、ＡＮＤ回路４１と、このＡＮＤ回路４１の出力によって駆動されるＭＯＳＦＥＴ等のスイッチング素子４２とから構成されている。ＡＮＤ回路４１の両入力端子には、コンパレータ３５の出力とバイアス電流オン／オフ回路３８の出力とが入力され、両入力が共にハイレベルの時のみ、ＡＮＤ回路４１の出力がハイレベルに反転して、デューティ制御用のスイッチング素子４２がオンする。このスイッチング素子４２は、ソレノイドコイル４０の通電回路中に設けられているため、スイッチング素子４２がオンする

と、ソレノイドコイル４０に電流が流れる。

【００１９】バイアス電流オン／オフ回路３８は、パージ制御弁３１の閉弁状態が一定時間Ｔｄ以上継続した時にソレノイドコイル４０のバイアス電流をオフする回路であり、コンパレータ３５の出力の立上がり、立下がりのエッジを検出するエッジ検出回路４３、タイマ４４及びキャリー信号出力回路４５等から構成されている。エッジ検出回路４３は、コンパレータ３５の出力の立上がり、立下がりのいずれかのエッジを検出した時に、タイマ４４をクリアする。このタイマ４４は、クリア後の経過時間をカウントし、そのカウント値が一定時間Ｔｄ（デューティ信号Ｄｕｔｙの周期の少なくとも数倍以上の時間）に達した時、つまりコンパレータ３５の出力の立上がり／立下がりエッジが検出されない状態（パージ制御弁３１の閉弁状態）が一定時間Ｔｄに達した時に、キャリー信号出力回路４５からキャリー信号が出力され、このキャリー信号によってバイアス電流オン／オフ回路３８の出力がローレベルに反転する。このローレベル信号は、デューティ制御回路３７と後述するバイアス電流制御回路４６にそれぞれ入力され、双方の動作が禁止された状態となる。これにより、ソレノイドコイル４０のバイアス電流がオフされる。

【００２０】バイアス電流のオフ後、エッジ検出回路４３でコンパレータ３５の出力の立上がり、立下がりのいずれかのエッジが検出されれば、その時点で、バイアス電流オン／オフ回路３８の出力がハイレベルに反転し、デューティ制御回路３７及びバイアス電流制御回路４６の動作が許可された状態となる。これにより、ソレノイドコイル４０に再び、バイアス電流が流れる。

【００２１】バイアス電流制御回路４６は、ソレノイドコイル４０に一定のバイアス電流を流す回路であり、バイアス電流を制御するＭＯＳＦＥＴ等のスイッチング素子４７と電流検出抵抗４８との直列回路が上述したデューティ制御用のスイッチング素子４２と並列に設けられている。ソレノイドコイル４０に流れるバイアス電流は、バイアス電流制御用のスイッチング素子４７を介して電流検出抵抗４８に流れ、この電流検出抵抗４８にバイアス電流に応じた電圧Ｖｂｉａｓが発生する。この電圧Ｖｂｉａｓは、コンパレータ５０の－入力端子に入力され、該コンパレータ５０の＋入力端子には、分圧回路５１の抵抗比で分圧されたバイアス電流設定用の基準電圧Ｖｒｅｆが入力される。コンパレータ５０は、バイアス電流検出電圧Ｖｂｉａｓと基準電圧Ｖｒｅｆとを比較し、その比較結果に応じて出力をハイレベル／ローレベルに切り換える。このコンパレータ５０の出力は、ＡＮＤ回路４９の一方の入力端子に入力され、該ＡＮＤ回路４９の他方の入力端子には、バイアス電流オン／オフ回路３８の出力が入力される。このＡＮＤ回路４９の出力によってスイッチング素子４７が駆動され、ソレノイドコイル４０に一定のバイアス電流が流される。

【００２２】デューティ制御中（パージ制御中）は、ＡＮＤ回路４９の一方の入力（バイアス電流オン／オフ回路３８の出力）がハイレベルに維持されるため、ＡＮＤ回路４９の出力レベルは、他方の入力端子に入力されるコンパレータ５０の出力に応じて切り換えられる。これにより、ソレノイドコイル４０に流れるバイアス電流が基準電圧Ｖｒｅｆで設定した目標値となるようにバイアス電流制御用のスイッチング素子４７のオン／オフが制御される。この場合、バイアス電流によるパージ制御弁３１の開弁方向の電磁力が閉弁時のばねによる閉弁力をほぼキャンセルするようにバイアス電流の目標値（基準電圧Ｖｒｅｆ）が設定されている。以上説明したバイアス電流制御回路４６及びバイアス電流オン／オフ回路３８は、特許請求の範囲でいうバイアス電流制御手段として機能する。

【００２３】一方、フェールセーフ回路３９は、パージ制御回路３３の異常を検出する異常検出回路５３と、電源電圧（＋Ｂ）を昇圧するチャージポンプ５４と、このチャージポンプ５４によって駆動されるＭＯＳＦＥＴ等のスイッチング素子５５とから構成され、ソレノイドコイル４０の通電回路中にスイッチング素子５５が接続されている。パージ制御回路３３が正常に動作している時には、異常検出回路５３からチャージポンプ５４に駆動信号が出力されて、チャージポンプ５４が駆動され、スイッチング素子５５がオン状態に保持される。そして、異常検出回路５３がパージ制御回路３３の異常を検出すると、チャージポンプ５４の駆動が停止され、スイッチング素子５５がオフしてソレノイドコイル４０への通電が遮断される。尚、ソレノイドコイル４０には、サージ吸収用のダイオード５２が並列に接続されている。

【００２４】以上説明した実施形態では、バイアス電流制御回路４６によりパージ制御弁３１のソレノイドコイル４０に一定のバイアス電流を流すと共に、バイアス電流による開弁方向の電磁力が閉弁時のばねによる閉弁力をほぼキャンセルするようにバイアス電流を制御するので、図４（ａ）に示すように、電源電圧の変動やコイル温度の変化によって電磁力（開弁力）が変化したとしても、パージ制御弁３１の開弁タイミングのずれをほぼ無くすことができる。このため、デューティ信号Ｄｕｔｙからパージ制御弁３１の開弁タイミングを判断してパージ制御による空燃比の変動を補正しても、この空燃比補正を従来［図４（ｂ）参照］よりも精度良く行うことが可能となり、パージ制御時のエミッションやドライバビリティを改善することができる。しかも、電流制御方式とは異なり、全領域でコイル電流をフィードバック制御する必要がなく、簡単な回路構成を採用することができ、低コスト化の要求を満たすことができる。

【００２５】尚、上記実施形態では、バイアス電流による開弁方向の電磁力が閉弁時のばねによる閉弁力をほぼキャンセルするように設定したが、バイアス電流による

開弁方向の電磁力を閉弁時のばねによる閉弁力の例えば９０％、８０％、７０％、…等のいずれかに設定しても良い。図４から明らかなように、バイアス電流による開弁方向の電磁力がばねによる閉弁力に近付くほど、電磁弁の開弁タイミングのずれが少なくなる。従って、バイアス電流による開弁方向の電磁力が閉弁時のばねによる閉弁力よりも小さい場合でも、従来［図４（ｂ）参照］と比較すれば、開弁タイミングのずれを少なくすることができ、パージ制御弁３１の開弁特性を向上することができる。

【００２６】また、上記実施形態では、パージ制御弁３１の閉弁状態が一定時間Ｔｄ以上継続した時に、バイアス電流オン／オフ回路３８によりソレノイドコイル４０のバイアス電流をオフするようにしたので、パージ制御弁３１の開弁中のバイアス電流による消費電力増加やコイル温度上昇を回避できると共に、ばねによる閉弁力を確実に働かせてパージ制御弁３１を閉弁状態に確実に保持することができる。

【００２７】尚、上記実施形態では、バイアス電流が一旦オフされると、その後、コンパレータ３５の出力（デューティ信号Ｄｕｔｙを反転した信号）の立上がり／立下がりエッジが検出されるまで、バイアス電流がオフされた状態が続くようになっているが、例えば、バイアス電流がオフされている時には、エンジン制御回路３２内のマイクロコンピュータからデューティ信号Ｄｕｔｙを出力する前に、バイアス電流通電再開用のパルスを出力し、このパルスによってバイアス電流オン／オフ回路３８の出力をハイレベルに反転させてバイアス電流の通電を再開した後にデューティ信号Ｄｕｔｙを出力するようにしても良い。

【００２８】また、上記実施形態では、ソレノイドコイル４０によるサージ電圧を吸収する手段としてダイオード５２を用いたが、これに代えて、ツェナーダイオードやＣＲ回路等を使用したサージ吸収回路を用いても良い。また、スイッチング素子４２，４７，５５は、ＭＯＳＦＥＴに代えて、バイポーラトランジスタ、ＩＧＢＴ、サイリスタ等の他のスイッチング素子を使用しても良い。

【００２９】その他、本発明は、パージ制御弁の制御装置に限定されず、例えばアイドルスピードコントロールバルブ（ＩＳＣＶ）等、自動車に使用される各種の電磁弁や、自動車以外に使用される各種の電磁弁の制御装置にも適用可能である。

【図面の簡単な説明】

【図１】本発明を燃料蒸発ガスパージシステムに適用した一実施形態におけるパージ制御回路の構成を示す回路図

【図２】パージ制御回路の各部の電圧波形を示すタイムチャート

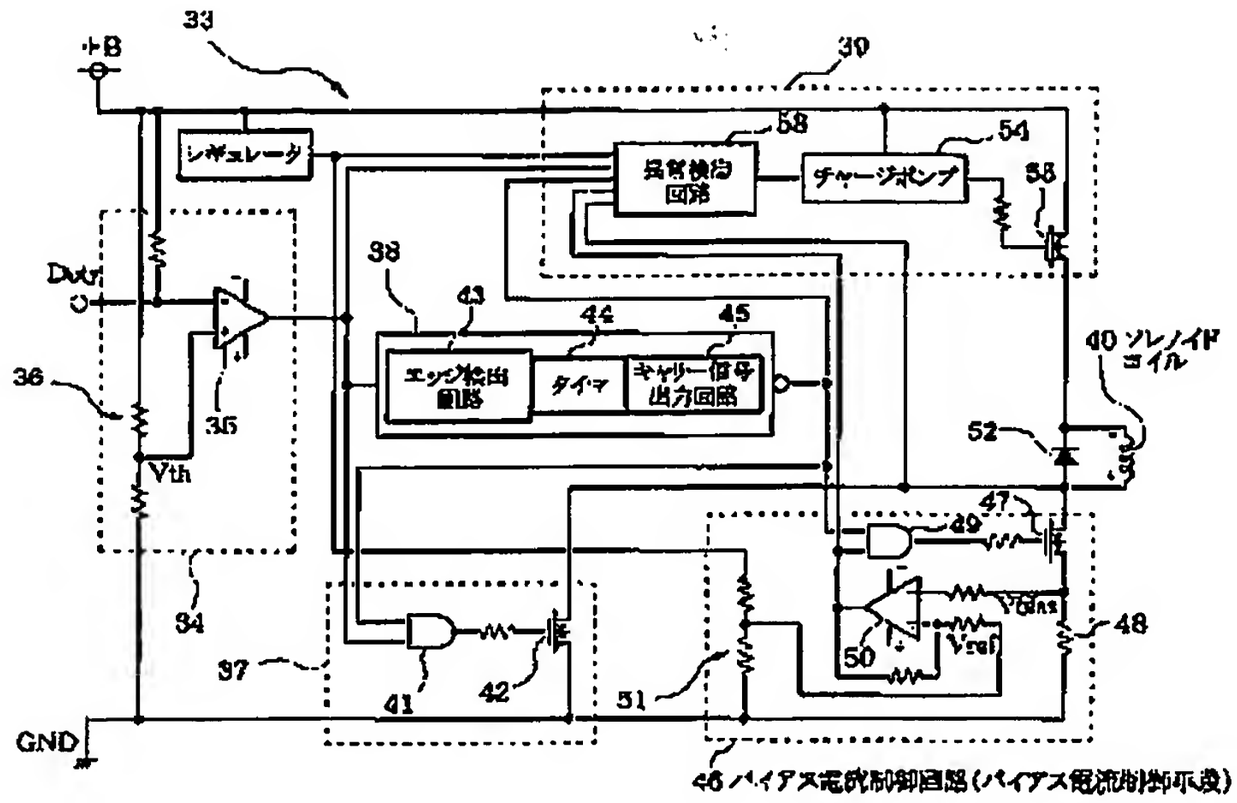
【図３】燃料蒸発ガスパージシステムの構成を概略的に示す図

【図４】（ａ）は本発明の実施形態におけるパージ制御弁の開弁特性を示す図、（ｂ）は従来のパージ制御弁の開弁特性を示す図

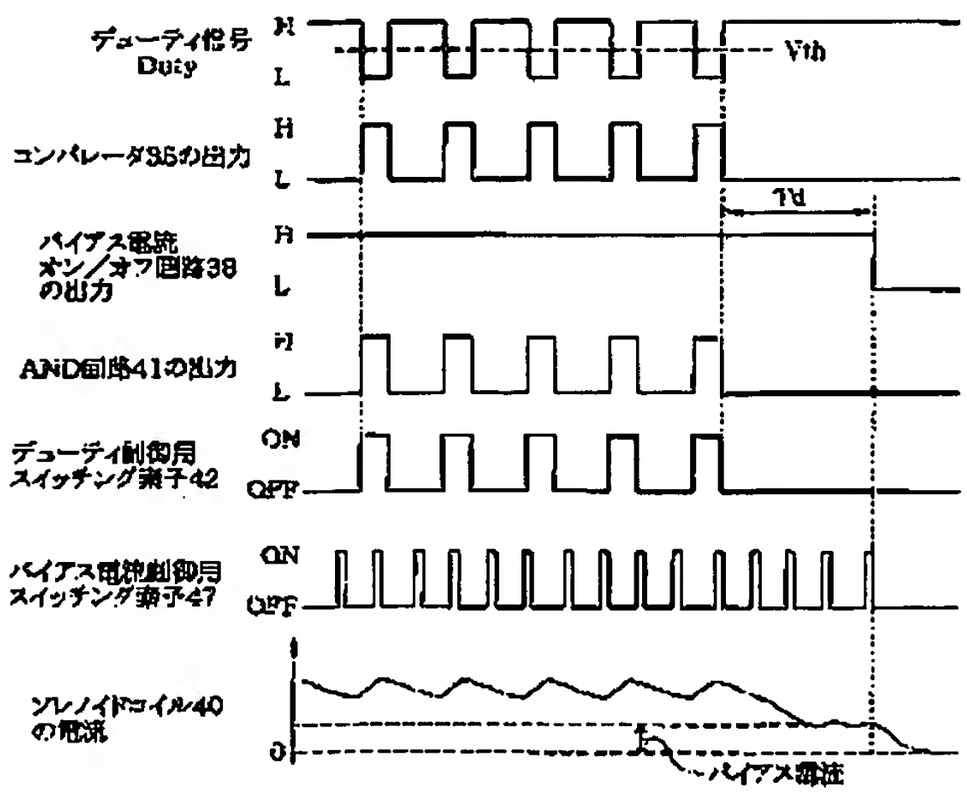
【符号の説明】

１２…吸気管、１７…燃料タンク、２１…燃料蒸発ガスパージシステム、２３…キャニスタ、２４…吸着体、２６…キャニスタ閉塞弁、３０ａ，３０ｂ…パージ通路、３１…パージ制御弁（電磁弁）、３２…エンジン制御回路、３３…パージ制御回路、３７…デューティ制御回路、３８…バイアス電流オン／オフ回路（バイアス電流制御手段）、３９…フェールセーフ回路、４０…ソレノイドコイル、４２…スイッチング素子、４６…バイアス電流制御回路（バイアス電流制御手段）、４７…スイッチング素子、４８…電流検出抵抗、５３…異常検出回路、５５…スイッチング素子。

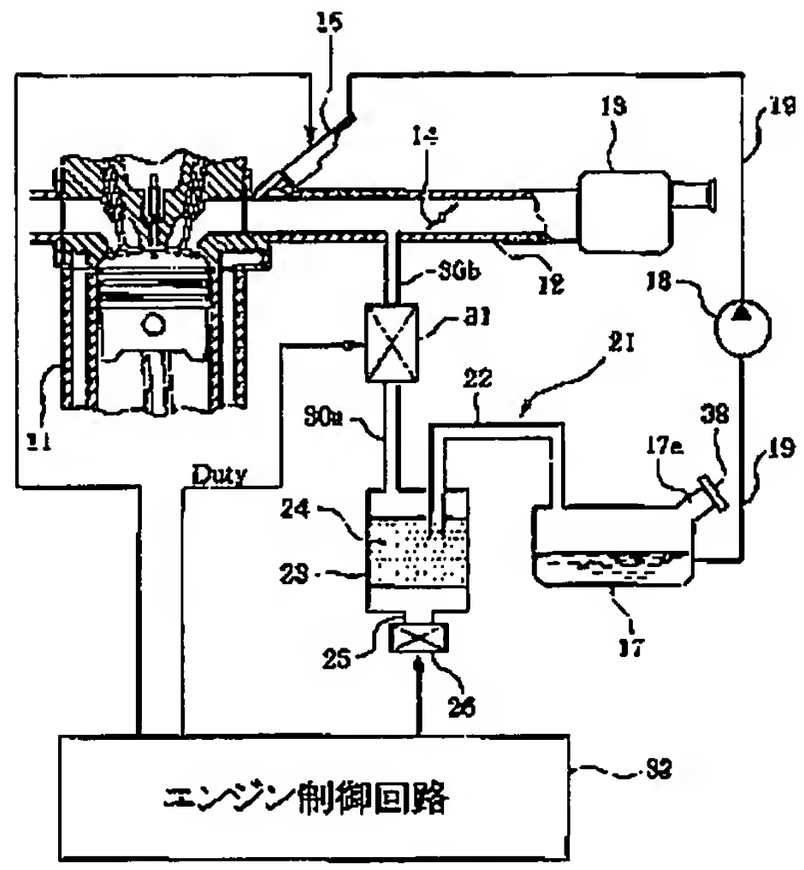
【図１】


+B
33
30
58
54
56
38
43
44
45
40 ソレノイドコイル
36
35
Vth
52
47
49
34
37
41
42
51
50
48
GND
46 バイアス電流制御回路（バイアス電流制御手段）

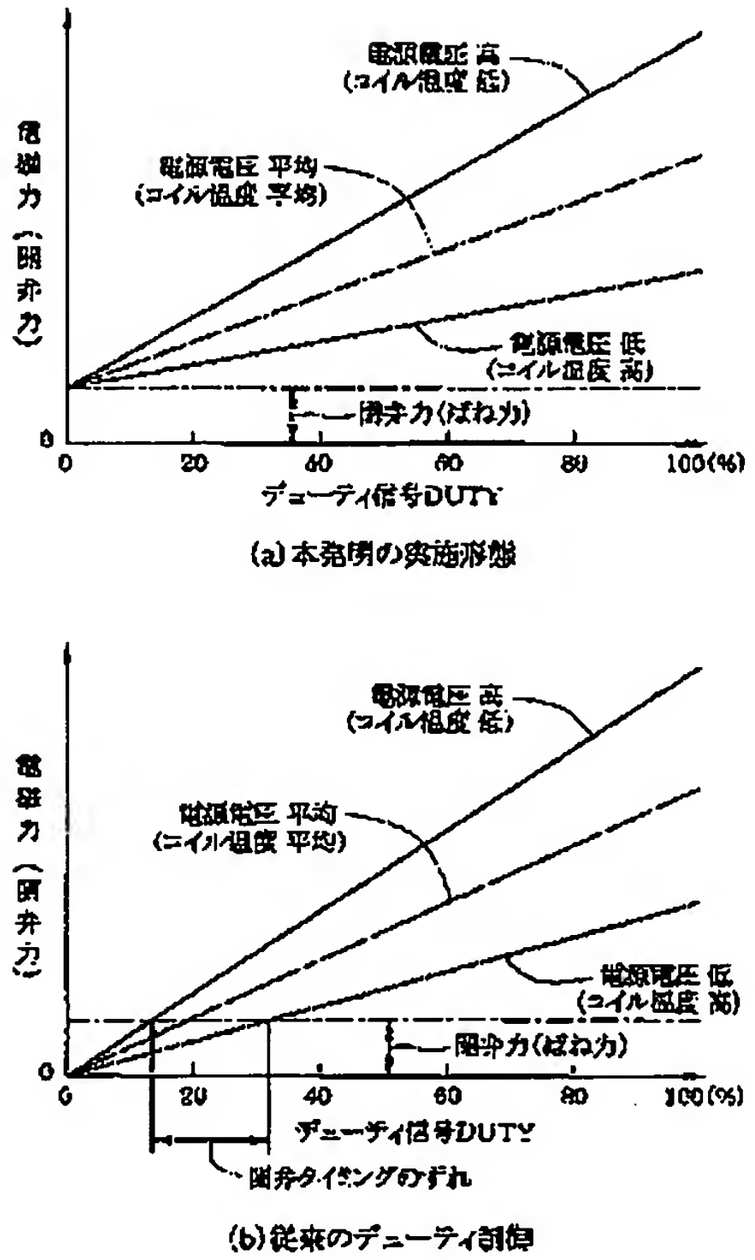
【図２】


デューティ信号 Duty
H
L
Vth
コンパレータ35の出力
H
L
Td
バイアス電流 オン／オフ回路38 の出力
H
L
AND回路41の出力
H
L
デューティ制御用 スイッチング素子42
ON
OFF
バイアス電流制御用 スイッチング素子47
ON
OFF
ソレノイドコイル40 の電流
0
バイアス電流

【図３】



【図４】



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(71)Applicant : DENSO CORP

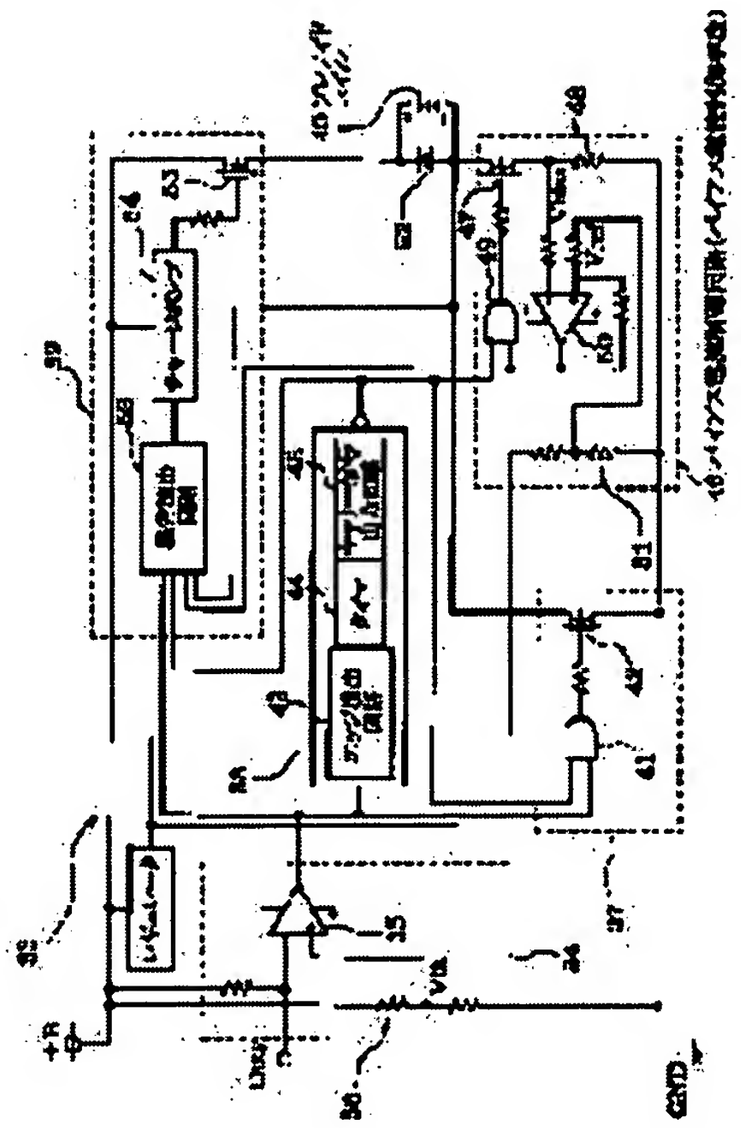
(72)Inventor : TARUI ATSUSHI

(54) SOLENOID VALVE CONTROL DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance the valve opening control characteristics of a solenoid valve compatibly with achievement of low cost.

SOLUTION: A bias current control circuit 46 is the one for feeding a definite bias current to a solenoid coil 40 of a purge control valve (solenoid operated), in which a series circuitry of a switching element 47 such as MOSFET for control of the bias current and a current sensing resistance 48 is installed parallel with a switching element 42 for duty control. The bias current flowing in the solenoid coil 40 is detected by the resistance 48, and the control circuit 46 controls the operation of the switching element 47 so that the bias current becomes identical to the target. The target for the bias current is set so that the valve closing force of a spring at the time of valve closing is canceled substantially by the electromagnetic force in opening direction of the purge control valve based on the bias current. This enables to eliminate substantially a dislocation of the opening timing of the purge control valve even though a variation exists in the source voltage and/or coil temperature.



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[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] The solenoid-valve control device characterized by having the bias current control means which passes a predetermined bias current to said solenoid coil in the solenoid-valve control device which energizes the valve element of a solenoid valve in the direction of clausilium with a spring, resists said spring, drives said valve element in the valve-opening direction by passing a current to the solenoid coil of this solenoid valve, and controls the opening of a solenoid valve.
[Claim 2] Said bias current control means is a solenoid-valve control unit according to claim 1 characterized by setting up said bias current so that the electromagnetic force of the valve-opening direction by said bias current may cancel mostly the clausilium force with said spring at the time of clausilium.
[Claim 3] Said bias current control means is a solenoid-valve control unit according to claim 1 or 2 characterized by turning off said bias current when the clausilium condition of said solenoid valve continues beyond predetermined time.
[Claim 4] Said solenoid valve is a solenoid-valve control unit according to claim 1 to 3 characterized by being prepared as a purge control valve in the middle of the purge path which purges the evaporative gas produced from the inside of a fuel tank to an internal combustion engine's inlet pipe.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the solenoid-valve control unit which has improved the valve-opening property of a solenoid valve.
[0002]
[Description of the Prior Art] Conventionally, the solenoid valve is used abundantly as a means to control the flow of various fluids, for example, the solenoid valve is used by automobile as a purge control valve, an idle speed control valve (ISCV), etc. of an evaporative gas purge system. The canister which adsorbs evaporative gas in the middle of and a purge control valve are prepared, it is controlling this purge control valve, and the amount of purges of the evaporative gas purged from a canister to an inlet pipe is controlled. [the purge path which purges the evaporative gas (evaporated gas) with which the fuel in a fuel tank evaporated and produced the evaporative gas purge system here to an internal combustion engine's inlet pipe]
[0003] the electromagnetism for which current and the purge control valve currently used used the solenoid valve -- although there is a negative pressure drive type (refer to JP,62-153553,A) using the pneumatic bulb which makes a pressure source inlet-pipe negative pressure besides a drive type, since it is necessary to prepare piping which introduces inlet-pipe negative pressure, there is a fault which becomes cost quantity by the negative pressure drive formula.
[0004] on the other hand -- electromagnetism -- the purge control valve (refer to JP,10-9009,A) of a drive type controls the amount of purges of evaporative gas by controlling the ratio of the valve-opening time amount (ON time amount) of a purge control valve, and clausilium time amount (off time amount). However, if valve opening/clausilium of a purge control valve (purge activation / halt) are repeated frequently, since the amount of evaporative gas purges which flows into an inlet pipe from a canister will pulsate, the air-fuel ratio of the gaseous mixture inhaled in an internal combustion engine's gas column will be confused, and emission and drivability will get worse. In order to improve this, there are some which control the opening of a purge control valve by carrying out duty control of the applied voltage to a linear solenoid, and controlled the amount of purges of evaporative gas by it using the purge control valve which makes a linear solenoid a driving source.
[0005]
[Problem(s) to be Solved by the Invention] By the way, since the spring which energizes a valve element in the direction of clausilium is built in a purge control valve (solenoid valve) and a clausilium condition is maintained according to this spring force, in order to open, it is necessary to generate at least only the electromagnetic force (valve-opening force) which overcomes the clausilium force with a spring in a solenoid.
[0006] During car operation, since supply voltage is changed or coil resistance changes with change of coil temperature, as the applied voltage to a solenoid shown to drawing 4 (b) in the method which carries out duty control, the current value which flows to a solenoid coil by fluctuation of supply voltage or change of coil temperature will change, the electromagnetic force of a solenoid will change a lot, and

the duty signal DUTY in case a purge control valve actually begins to open from a clausilium condition will change a lot.

[0007] In order for the amount of purges of evaporative gas to increase rapidly and to make an air-fuel ratio change suddenly immediately after valve opening of a purge control valve, Although it is desirable to amend an air-fuel ratio according to the amount of purges to valve opening and coincidence of a purge control valve, in the conventional duty control system Since the valve-opening timing of a purge control valve shifts greatly by fluctuation of supply voltage, or change of coil temperature as shown in drawing 4 (b), An engine control circuit cannot understand valve-opening timing of an actual purge control valve, and sudden change of the air-fuel ratio by valve opening of a purge control valve cannot be amended with a sufficient precision.

[0008] In order to cancel this fault, there are some which adopted the purge control valve of the current control system which controls electromagnetic force (coil current value) by carrying out feedback control of the current passed to a solenoid coil in recent years not to be influenced [fluctuation of supply voltage or] by coil temperature of change. However, in this current control system, since it is necessary to carry out feedback control of the coil current in all fields, the configuration of a control circuit is complicated and there is a fault which carries out a cost rise.

[0009] This invention is made in consideration of such a situation, therefore the purpose is in offering the solenoid-valve control unit which can reconcile the improvement in the valve-opening control characteristic and low-cost-izing of a solenoid valve.

[0010]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the solenoid-valve control device of claim 1 of this invention is passing a predetermined bias current to a solenoid coil by the bias current control means, and generates the electromagnetic force of the valve-opening direction which opposes the clausilium force with a spring. A gap of the valve-opening timing of a solenoid valve decreases, so that the electromagnetic force of the valve-opening direction by this bias current approaches the clausilium force with a spring (refer to drawing 4). Therefore, if duty control is performed for a bias current with a sink, the opening of a solenoid valve is controllable with a sufficient precision from the conventional duty control. And it is not necessary to carry out feedback control of the coil current in all fields, and, unlike a current control system, easy circuitry can be adopted.

[0011] In this case, it is desirable to set up a bias current like claim 2, so that the electromagnetic force of the valve-opening direction by the bias current may cancel mostly the clausilium force with the spring at the time of clausilium. If it does in this way, even if there are fluctuation of supply voltage and change of coil temperature, a gap of the valve-opening timing of a solenoid valve can be lost mostly.

[0012] Moreover, when the clausilium condition of a solenoid valve continues beyond predetermined time, you may make it turn off a bias current like claim 3. That is, while being able to avoid the increment in power consumption and coil temperature rise by the bias current in the clausilium of a solenoid valve if a bias current is turned off since it is not necessary to pass a bias current when the clausilium condition of a solenoid valve continues for a long time, the clausilium force with a spring can be used certainly and a solenoid valve can be certainly held in the clausilium condition.

[0013] Although the solenoid-valve control unit of this invention explained above can apply the flow of various fluids to the system controlled by the solenoid valve, if it applies to an evaporative gas purge system, big effectiveness will be especially acquired like claim 4. That is, in order for the amount of purges of evaporative gas to increase rapidly and to make an air-fuel ratio change suddenly immediately after valve opening of a purge control valve, it is desirable to amend an air-fuel ratio according to the amount of purges to valve opening and coincidence of a purge control valve. Since a gap of valve-opening timing is few (or zero) as compared with the conventional duty control system, the solenoid-valve control device of this invention becomes possible [amending sudden change of the air-fuel ratio by valve opening of a purge control valve with a sufficient precision], and can improve the emission and drivability at the time of purge control.

[0014]

[Embodiment of the Invention] Hereafter, 1 operation gestalt which applied this invention to the

evaporative gas purge system is explained based on a drawing. First, the outline configuration of the whole system is explained based on drawing 3 . An air cleaner 13 is formed in the upstream of the inlet pipe 12 of an engine 11, and the air which passed this air cleaner 13 is inhaled by each gas column of an engine 11 through a throttle valve 14. Moreover, a fuel injection valve 16 is formed in the suction port of each gas column of an inlet pipe 12, and the fuel in a fuel tank 17 (gasoline) is sent to each fuel injection valve 16 through a fuel line 19 by the fuel pump 18.

[0015] Next, the configuration of the evaporative gas purge system 21 is explained. A canister 23 is connected to a fuel tank 17 through the communicating tube 22, and it is adsorbed by adsorbent 24, such as activated carbon held in this canister 23, in evaporative gas. The atmospheric-air communicating tube 25 which is open for free passage to atmospheric air is formed in the bottom surface part of this canister 23, and the canister lock out valve 26 is attached in this atmospheric-air communicating tube 25. This canister lock out valve 26 is constituted by the solenoid valve of a normally open mold, during purge control, is maintained by the OFF state (valve-opening condition), and is held at the condition that the inside of a canister 23 was wide opened by atmospheric air.

[0016] On the other hand, between a canister 23 and an inlet pipe 12, the purge paths 30a and 30b for purging the evaporative gas with which adsorbent 24 was adsorbed to an inlet pipe 12 (emission) are formed, and the purge control valve 31 which adjusts a purge flow rate between this purge path 30a and 30b is formed in it. This purge control valve 31 is constituted by the solenoid valve of a normally closed mold, and is held in the clausilium condition with the built-in spring (not shown) at the time of OFF. This purge control valve 31 is controlled by the microcomputer (not shown) and the purge control circuit 33 (refer to drawing 1) which were prepared in the engine control circuit 32. The microcomputer in the engine control circuit 32 calculates the target opening (rate of a target purge) of the purge control valve 31 according to an engine operation condition, and outputs the duty signal Duty according to the target opening to the purge control circuit 33.

[0017] Next, the configuration of the purge control circuit 33 is explained based on drawing 1 . The comparator 35 is built in the input interface circuitry 34 of the purge control circuit 33. The duty signal Duty outputted from the microcomputer in the engine control circuit 32 is inputted into - input terminal of this comparator 35, and the reference voltage Vth by which the partial pressure was carried out by the resistance ratio of the partial pressure circuit 36 is inputted into + input terminal of this comparator 35. The duty signal Duty is compared with reference voltage Vth, as shown in drawing 2 , when the duty signal Duty is high level (Duty>Vth), the output of this comparator 35 serves as a low level, and when the duty signal Duty is a low level (Duty<Vth), it becomes high-level outputting [of this comparator 35] a comparator 35.

[0018] The output (signal which reversed the duty signal Duty) of this comparator 35 is inputted into the duty control circuit 37, the bias current ON / off circuit 38, and the fail-safe circuit 39, respectively. The duty control circuit 37 is a circuit which carries out duty control of the energization to the solenoid coil 40 of the purge control valve 31, and consists of AND circuit 41 and switching elements 42, such as MOSFET driven with the output of this AND circuit 41. The output of a comparator 35 and the output of bias current ON / OFF circuit 38 are inputted into both the input terminals of AND circuit 41, only when both inputs of both are high-level, the output of AND circuit 41 is reversed high-level, and the switching element 42 for duty control turns on. Since this switching element 42 is formed all over the energization circuit of a solenoid coil 40, if a switching element 42 turns on, a current will flow to a solenoid coil 40.

[0019] For bias current ON / off circuit 38, the clausilium condition of the purge control valve 31 is fixed time amount Td. When it continues above, it is the circuit which turns off the bias current of a solenoid coil 40, and it consists of the edge detectors 43, the timers 44, and carry signal output circuit 45 grades which detect the start of the output of a comparator 35, and the edge of a fall. The edge detector 43 clears a timer 44, when the edge of the start of the output of a comparator 35 and either of the falls is detected. When this timer 44 counts the elapsed time after clear and that counted value reaches fixed time amount Td (time amount of at least several times or more of the period of the duty signal Duty), That is, the condition (clausilium condition of the purge control valve 31) that the start / fall edge of the

output of a comparator 35 are not detected is fixed time amount Td. When it reaches A carry signal is outputted from the carry signal output circuit 45, and the output of bias current ON / off circuit 38 is reversed to a low level with this carry signal. This low-level signal is inputted into the duty control circuit 37 and the bias current control circuit 46 mentioned later, respectively, and will be in the condition that actuation of both sides was forbidden. Thereby, the bias current of a solenoid coil 40 is turned off.

[0020] If the edge of the start of the output of a comparator 35 and either of the falls is detected after [of a bias current] off, and in the edge detector 43, at the time, the output of bias current ON / off circuit 38 is reversed high-level, and it will be in the condition that actuation of the duty control circuit 37 and the bias current control circuit 46 was permitted. Thereby, a bias current flows again to a solenoid coil 40.

[0021] The bias current control circuit 46 is a circuit which passes a fixed bias current to a solenoid coil 40, and is established in the switching element 42 for duty control and juxtaposition which the series circuit of the switching elements 47, such as MOSFET which controls a bias current, and the current detection resistance 48 mentioned above. The bias current which flows to a solenoid coil 40 flows to the current detection resistance 48 through the switching element 47 for bias current control, and the electrical potential difference Vbias according to a bias current generates it in this current detection resistance 48. This electrical potential difference Vbias is the reference voltage Vref for a bias current setup by which was inputted into - input terminal of a comparator 50, and the partial pressure was carried out to + input terminal of this comparator 50 by the resistance ratio of the partial pressure circuit 51. It is inputted. A comparator 50 is the bias current detection electrical potential difference Vbias and reference voltage Vref. It compares and an output is switched to high level/low level according to the comparison result. The output of this comparator 50 is inputted into one input terminal of AND circuit 49, and the output of bias current ON / off circuit 38 is inputted into the input terminal of another side of this AND circuit 49. With the output of this AND circuit 49, a switching element 47 drives and a fixed bias current is passed by the solenoid coil 40.

[0022] During duty control (under purge control), since one input (output of bias current ON / off circuit 38) of AND circuit 49 is maintained high-level, the output level of AND circuit 49 is switched according to the output of the comparator 50 inputted into the input terminal of another side. Thereby, the bias current which flows to a solenoid coil 40 is reference voltage Vref. ON/OFF of the switching element 47 for bias current control are controlled to become the set-up desired value. In this case, the desired value (reference voltage Vref) of a bias current is set up so that the electromagnetic force of the valve-opening direction of the purge control valve 31 by the bias current may cancel mostly the clausilium force with the spring at the time of clausilium. The bias current control circuit 46, and the bias current ON / off circuit 38 explained above functions as a bias current control means as used in the field of a claim.

[0023] On the other hand, the fail-safe circuit 39 consists of a malfunction detection circuit 53 which detects the abnormalities of the purge control circuit 33, a charge pump 54 which carries out the pressure up of the supply voltage (+B), and switching elements 55, such as MOSFET driven with this charge pump 54, and the switching element 55 is connected all over the energization circuit of a solenoid coil 40. While the purge control circuit 33 is operating normally, a driving signal is outputted to the charge pump 54 from the malfunction detection circuit 53, the charge pump 54 drives, and a switching element 55 is held at an ON state. And if the malfunction detection circuit 53 detects the abnormalities of the purge control circuit 33, the drive of the charge pump 54 will be stopped, a switching element 55 will turn off, and the energization to a solenoid coil 40 will be intercepted. In addition, the diode 52 for surge absorption is connected to the solenoid coil 40 at juxtaposition.

[0024] With the operation gestalt explained above, while passing a fixed bias current to the solenoid coil 40 of the purge control valve 31 by the bias current control circuit 46 Since a bias current is controlled so that the electromagnetic force of the valve-opening direction by the bias current cancels mostly the clausilium force with the spring at the time of clausilium As shown in drawing 4 (a), even if electromagnetic force (valve-opening force) changes with fluctuation of supply voltage, or change of coil temperature, a gap of the valve-opening timing of the purge control valve 31 can be lost mostly. For

this reason, even if it judges the valve-opening timing of the purge control valve 31 from the duty signal Duty and amends fluctuation of the air-fuel ratio by purge control, it becomes possible to perform this air-fuel ratio amendment with a precision more sufficient than [referring to drawing 4 (b)] conventionally, and the emission and drivability at the time of purge control can be improved. And it is not necessary to carry out feedback control of the coil current in all fields, unlike a current control system, easy circuitry can be adopted, and the demand of low-cost-izing can be filled.

[0025] In addition, although it set up with the above-mentioned operation gestalt so that the electromagnetic force of the valve-opening direction by the bias current might cancel mostly the clausilium force with the spring at the time of clausilium, the electromagnetic force of the valve-opening direction by the bias current may be set as either, such as --, the clausilium force with the spring at the time of clausilium, for example, 90%, 80%, and 70%. A gap of the valve-opening timing of a solenoid valve decreases, so that from drawing 4 and the electromagnetic force of the valve-opening direction by the bias current approaches the clausilium force with a spring. Therefore, if it compares with [refer to drawing 4 (b)] conventionally even when the electromagnetic force of the valve-opening direction by the bias current is smaller than the clausilium force with the spring at the time of clausilium, a gap of valve-opening timing can be lessened and the valve-opening property of the purge control valve 31 can be improved.

[0026] Moreover, at the above-mentioned operation gestalt, the clausilium condition of the purge control valve 31 is fixed time amount Td. While being able to avoid the increment in power consumption and coil temperature rise by the bias current in the clausilium of the purge control valve 31 since the bias current of a solenoid coil 40 was turned off by bias current ON / OFF circuit 38 when it continues above, the clausilium force with a spring can be used certainly and the purge control valve 31 can be certainly held in the clausilium condition.

[0027] In addition, although the condition that the bias current was turned off will continue with the above-mentioned operation gestalt until the start / fall edge of the output (signal which reversed the duty signal Duty) of a comparator 35 are detected after that once a bias current is turned off for example, when the bias current is turned off Before outputting the duty signal Duty from the microcomputer in the engine control circuit 32 The pulse for resumption of bias current energization is outputted, and after reversing the output of bias current ON / off circuit 38 high-level and resuming energization of a bias current by this pulse, you may make it output the duty signal Duty.

[0028] Moreover, although diode 52 was used as a means to absorb the surge voltage by the solenoid coil 40, with the above-mentioned operation gestalt, it may replace with this and the surge absorber which used zener diode, a CR circuit, etc. may be used. Moreover, switching elements 42, 47, and 55 may be replaced with MOSFET, and other switching elements, such as a bipolar transistor, IGBT, and a thyristor, may be used for them.

[0029] In addition, this invention is applicable also to the control device of various kinds of solenoid valves which are not limited to the control device of a purge control valve, for example, are used for automobiles, such as an idle speed control valve (ISCV), and various kinds of solenoid valves used in addition to an automobile.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the solenoid-valve control unit which has improved the valve-opening property of a solenoid valve.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, since the spring which energizes a valve element in the direction of clausilium is built in a purge control valve (solenoid valve) and a clausilium condition is maintained according to this spring force, in order to open, it is necessary to generate at least only the electromagnetic force (valve-opening force) which overcomes the clausilium force with a spring in a solenoid.
[0006] During car operation, since supply voltage is changed or coil resistance changes with change of coil temperature, as the applied voltage to a solenoid shown to drawing 4 (b) in the method which carries out duty control, the current value which flows to a solenoid coil by fluctuation of supply voltage or change of coil temperature will change, the electromagnetic force of a solenoid will change a lot, and the duty signal DUTY in case a purge control valve actually begins to open from a clausilium condition will change a lot.
[0007] In order for the amount of purges of evaporative gas to increase rapidly and to make an air-fuel ratio change suddenly immediately after valve opening of a purge control valve, Although it is desirable to amend an air-fuel ratio according to the amount of purges to valve opening and coincidence of a purge control valve, in the conventional duty control system Since the valve-opening timing of a purge control valve shifts greatly by fluctuation of supply voltage, or change of coil temperature as shown in drawing 4 (b), An engine control circuit cannot understand valve-opening timing of an actual purge control valve, and sudden change of the air-fuel ratio by valve opening of a purge control valve cannot be amended with a sufficient precision.
[0008] In order to cancel this fault, there are some which adopted the purge control valve of the current control system which controls electromagnetic force (coil current value) by carrying out feedback control of the current passed to a solenoid coil in recent years not to be influenced [fluctuation of supply voltage or] by coil temperature of change. However, in this current control system, since it is necessary to carry out feedback control of the coil current in all fields, the configuration of a control circuit is complicated and there is a fault which carries out a cost rise.
[0009] This invention is made in consideration of such a situation, therefore the purpose is in offering the solenoid-valve control unit which can reconcile the improvement in the valve-opening control characteristic and low-cost-izing of a solenoid valve.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the solenoid-valve control device of claim 1 of this invention is passing a predetermined bias current to a solenoid coil by the bias current control means, and generates the electromagnetic force of the valve-opening direction which opposes the clausilium force with a spring. A gap of the valve-opening timing of a solenoid valve decreases, so that the electromagnetic force of the valve-opening direction by this bias current approaches the clausilium force with a spring (refer to drawing 4). Therefore, if duty control is performed for a bias current with a sink, the opening of a solenoid valve is controllable with a sufficient precision from the conventional duty control. And it is not necessary to carry out feedback control of the coil current in all fields, and, unlike a current control system, easy circuitry can be adopted.
[0011] In this case, it is desirable to set up a bias current like claim 2, so that the electromagnetic force of the valve-opening direction by the bias current may cancel mostly the clausilium force with the spring at the time of clausilium. If it does in this way, even if there are fluctuation of supply voltage and change of coil temperature, a gap of the valve-opening timing of a solenoid valve can be lost mostly.
[0012] Moreover, when the clausilium condition of a solenoid valve continues beyond predetermined time, you may make it turn off a bias current like claim 3. That is, while being able to avoid the increment in power consumption and coil temperature rise by the bias current in the clausilium of a solenoid valve if a bias current is turned off since it is not necessary to pass a bias current when the clausilium condition of a solenoid valve continues for a long time, the clausilium force with a spring can be used certainly and a solenoid valve can be certainly held in the clausilium condition.
[0013] Although the solenoid-valve control unit of this invention explained above can apply the flow of various fluids to the system controlled by the solenoid valve, if it applies to an evaporative gas purge system, big effectiveness will be especially acquired like claim 4. That is, in order for the amount of purges of evaporative gas to increase rapidly and to make an air-fuel ratio change suddenly immediately after valve opening of a purge control valve, it is desirable to amend an air-fuel ratio according to the amount of purges to valve opening and coincidence of a purge control valve. Since a gap of valve-opening timing is few (or zero) as compared with the conventional duty control system, the solenoid-valve control device of this invention becomes possible [amending sudden change of the air-fuel ratio by valve opening of a purge control valve with a sufficient precision], and can improve the emission and drivability at the time of purge control.
[0014]
[Embodiment of the Invention] Hereafter, 1 operation gestalt which applied this invention to the evaporative gas purge system is explained based on a drawing. First, the outline configuration of the whole system is explained based on drawing 3 . An air cleaner 13 is formed in the upstream of the inlet pipe 12 of an engine 11, and the air which passed this air cleaner 13 is inhaled by each gas column of an engine 11 through a throttle valve 14. Moreover, a fuel injection valve 16 is formed in the suction port of each gas column of an inlet pipe 12, and the fuel in a fuel tank 17 (gasoline) is sent to each fuel injection valve 16 through a fuel line 19 by the fuel pump 18.
[0015] Next, the configuration of the evaporative gas purge system 21 is explained. A canister 23 is

connected to a fuel tank 17 through the communicating tube 22, and it is adsorbed by adsorbent 24, such as activated carbon held in this canister 23, in evaporative gas. The atmospheric-air communicating tube 25 which is open for free passage to atmospheric air is formed in the bottom surface part of this canister 23, and the canister lock out valve 26 is attached in this atmospheric-air communicating tube 25. This canister lock out valve 26 is constituted by the solenoid valve of a normally open mold, during purge control, is maintained by the OFF state (valve-opening condition), and is held at the condition that the inside of a canister 23 was wide opened by atmospheric air.

[0016] On the other hand, between a canister 23 and an inlet pipe 12, the purge paths 30a and 30b for purging the evaporative gas with which adsorbent 24 was adsorbed to an inlet pipe 12 (emission) are formed, and the purge control valve 31 which adjusts a purge flow rate between this purge path 30a and 30b is formed in it. This purge control valve 31 is constituted by the solenoid valve of a normally closed mold, and is held in the clausilium condition with the built-in spring (not shown) at the time of OFF. This purge control valve 31 is controlled by the microcomputer (not shown) and the purge control circuit 33 (refer to drawing 1) which were prepared in the engine control circuit 32. The microcomputer in the engine control circuit 32 calculates the target opening (rate of a target purge) of the purge control valve 31 according to an engine operation condition, and outputs the duty signal Duty according to the target opening to the purge control circuit 33.

[0017] Next, the configuration of the purge control circuit 33 is explained based on drawing 1 . The comparator 35 is built in the input interface circuitry 34 of the purge control circuit 33. The duty signal Duty outputted from the microcomputer in the engine control circuit 32 is inputted into - input terminal of this comparator 35, and the reference voltage Vth by which the partial pressure was carried out by the resistance ratio of the partial pressure circuit 36 is inputted into + input terminal of this comparator 35. The duty signal Duty is compared with reference voltage Vth, as shown in drawing 2 , when the duty signal Duty is high level (Duty>Vth), the output of this comparator 35 serves as a low level, and when the duty signal Duty is a low level (Duty<Vth), it becomes high-level outputting [of this comparator 35] a comparator 35.

[0018] The output (signal which reversed the duty signal Duty) of this comparator 35 is inputted into the duty control circuit 37, the bias current ON / off circuit 38, and the fail-safe circuit 39, respectively. The duty control circuit 37 is a circuit which carries out duty control of the energization to the solenoid coil 40 of the purge control valve 31, and consists of AND circuit 41 and switching elements 42, such as MOSFET driven with the output of this AND circuit 41. The output of a comparator 35 and the output of bias current ON / OFF circuit 38 are inputted into both the input terminals of AND circuit 41, only when both inputs of both are high-level, the output of AND circuit 41 is reversed high-level, and the switching element 42 for duty control turns on. Since this switching element 42 is formed all over the energization circuit of a solenoid coil 40, if a switching element 42 turns on, a current will flow to a solenoid coil 40.

[0019] For bias current ON / off circuit 38, the clausilium condition of the purge control valve 31 is fixed time amount Td. When it continues above, it is the circuit which turns off the bias current of a solenoid coil 40, and it consists of the edge detectors 43, the timers 44, and carry signal output circuit 45 grades which detect the start of the output of a comparator 35, and the edge of a fall. The edge detector 43 clears a timer 44, when the edge of the start of the output of a comparator 35 and either of the falls is detected. When this timer 44 counts the elapsed time after clear and that counted value reaches fixed time amount Td (time amount of at least several times or more of the period of the duty signal Duty), That is, the condition (clausilium condition of the purge control valve 31) that the start / fall edge of the output of a comparator 35 are not detected is fixed time amount Td. When it reaches A carry signal is outputted from the carry signal output circuit 45, and the output of bias current ON / off circuit 38 is reversed to a low level with this carry signal. This low-level signal is inputted into the duty control circuit 37 and the bias current control circuit 46 mentioned later, respectively, and will be in the condition that actuation of both sides was forbidden. Thereby, the bias current of a solenoid coil 40 is turned off.

[0020] If the edge of the start of the output of a comparator 35 and either of the falls is detected after [of

a bias current] off, and in the edge detector 43, at the time, the output of bias current ON / off circuit 38 is reversed high-level, and it will be in the condition that actuation of the duty control circuit 37 and the bias current control circuit 46 was permitted. Thereby, a bias current flows again to a solenoid coil 40.
[0021] The bias current control circuit 46 is a circuit which passes a fixed bias current to a solenoid coil 40, and is established in the switching element 42 for duty control and juxtaposition which the series circuit of the switching elements 47, such as MOSFET which controls a bias current, and the current detection resistance 48 mentioned above. The bias current which flows to a solenoid coil 40 flows to the current detection resistance 48 through the switching element 47 for bias current control, and the electrical potential difference Vbias according to a bias current generates it in this current detection resistance 48. This electrical potential difference Vbias is the reference voltage Vref for a bias current setup by which was inputted into - input terminal of a comparator 50, and the partial pressure was carried out to + input terminal of this comparator 50 by the resistance ratio of the partial pressure circuit 51. It is inputted. A comparator 50 is the bias current detection electrical potential difference Vbias and reference voltage Vref. It compares and an output is switched to high level/low level according to the comparison result. The output of this comparator 50 is inputted into one input terminal of AND circuit 49, and the output of bias current ON / off circuit 38 is inputted into the input terminal of another side of this AND circuit 49. With the output of this AND circuit 49, a switching element 47 drives and a fixed bias current is passed by the solenoid coil 40.
[0022] During duty control (under purge control), since one input (output of bias current ON / off circuit 38) of AND circuit 49 is maintained high-level, the output level of AND circuit 49 is switched according to the output of the comparator 50 inputted into the input terminal of another side. Thereby, the bias current which flows to a solenoid coil 40 is reference voltage Vref. ON/OFF of the switching element 47 for bias current control are controlled to become the set-up desired value. In this case, the desired value (reference voltage Vref) of a bias current is set up so that the electromagnetic force of the valve-opening direction of the purge control valve 31 by the bias current may cancel mostly the clausilium force with the spring at the time of clausilium. The bias current control circuit 46, and the bias current ON / off circuit 38 explained above functions as a bias current control means as used in the field of a claim.
[0023] On the other hand, the fail-safe circuit 39 consists of a malfunction detection circuit 53 which detects the abnormalities of the purge control circuit 33, a charge pump 54 which carries out the pressure up of the supply voltage (+B), and switching elements 55, such as MOSFET driven with this charge pump 54, and the switching element 55 is connected all over the energization circuit of a solenoid coil 40. While the purge control circuit 33 is operating normally, a driving signal is outputted to the charge pump 54 from the malfunction detection circuit 53, the charge pump 54 drives, and a switching element 55 is held at an ON state. And if the malfunction detection circuit 53 detects the abnormalities of the purge control circuit 33, the drive of the charge pump 54 will be stopped, a switching element 55 will turn off, and the energization to a solenoid coil 40 will be intercepted. In addition, the diode 52 for surge absorption is connected to the solenoid coil 40 at juxtaposition.
[0024] With the operation gestalt explained above, while passing a fixed bias current to the solenoid coil 40 of the purge control valve 31 by the bias current control circuit 46 Since a bias current is controlled so that the electromagnetic force of the valve-opening direction by the bias current cancels mostly the clausilium force with the spring at the time of clausilium As shown in drawing 4 (a), even if electromagnetic force (valve-opening force) changes with fluctuation of supply voltage, or change of coil temperature, a gap of the valve-opening timing of the purge control valve 31 can be lost mostly. For this reason, even if it judges the valve-opening timing of the purge control valve 31 from the duty signal Duty and amends fluctuation of the air-fuel ratio by purge control, it becomes possible to perform this air-fuel ratio amendment with a precision more sufficient than [referring to drawing 4 (b)] conventionally, and the emission and drivability at the time of purge control can be improved. And it is not necessary to carry out feedback control of the coil current in all fields, unlike a current control system, easy circuitry can be adopted, and the demand of low-cost-izing can be filled.
[0025] In addition, although it set up with the above-mentioned operation gestalt so that the

electromagnetic force of the valve-opening direction by the bias current might cancel mostly the clausilium force with the spring at the time of clausilium, the electromagnetic force of the valve-opening direction by the bias current may be set as either, such as --, the clausilium force with the spring at the time of clausilium, for example, 90%, 80%, and 70%. A gap of the valve-opening timing of a solenoid valve decreases, so that from drawing 4 and the electromagnetic force of the valve-opening direction by the bias current approaches the clausilium force with a spring. Therefore, if it compares with [refer to drawing 4 (b)] conventionally even when the electromagnetic force of the valve-opening direction by the bias current is smaller than the clausilium force with the spring at the time of clausilium, a gap of valve-opening timing can be lessened and the valve-opening property of the purge control valve 31 can be improved.

[0026] Moreover, at the above-mentioned operation gestalt, the clausilium condition of the purge control valve 31 is fixed time amount Td. While being able to avoid the increment in power consumption and coil temperature rise by the bias current in the clausilium of the purge control valve 31 since the bias current of a solenoid coil 40 was turned off by bias current ON / OFF circuit 38 when it continues above, the clausilium force with a spring can be used certainly and the purge control valve 31 can be certainly held in the clausilium condition.

[0027] In addition, although the condition that the bias current was turned off will continue with the above-mentioned operation gestalt until the start / fall edge of the output (signal which reversed the duty signal Duty) of a comparator 35 are detected after that once a bias current is turned off for example, when the bias current is turned off Before outputting the duty signal Duty from the microcomputer in the engine control circuit 32 The pulse for resumption of bias current energization is outputted, and after reversing the output of bias current ON / off circuit 38 high-level and resuming energization of a bias current by this pulse, you may make it output the duty signal Duty.

[0028] Moreover, although diode 52 was used as a means to absorb the surge voltage by the solenoid coil 40, with the above-mentioned operation gestalt, it may replace with this and the surge absorber which used zener diode, a CR circuit, etc. may be used. Moreover, switching elements 42, 47, and 55 may be replaced with MOSFET, and other switching elements, such as a bipolar transistor, IGBT, and a thyristor, may be used for them.

[0029] In addition, this invention is applicable also to the control device of various kinds of solenoid valves which are not limited to the control device of a purge control valve, for example, are used for automobiles, such as an idle speed control valve (ISCV), and various kinds of solenoid valves used in addition to an automobile.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The circuit diagram showing the configuration of the purge control circuit in 1 operation gestalt which applied this invention to the evaporative gas purge system
[Drawing 2] The timing diagram which shows the voltage waveform of each part of a purge control circuit
[Drawing 3] Drawing showing roughly the evaporative gas purge structure of a system
[Drawing 4] For (a), (b) is drawing showing the valve-opening property of the purge control valve in the operation gestalt of this invention, and drawing showing the valve-opening property of the conventional purge control valve.
[Description of Notations]
12 -- An inlet pipe, 17 -- A fuel tank, 21 -- Evaporative gas purge system, 23 [-- Purge path,] -- A canister, 24 -- Adsorbent, 26 -- A canister lock out valve, 30a, 30b 31 -- A purge control valve (solenoid valve), 32 -- An engine control circuit, 33 -- Purge control circuit, 37 -- A duty control circuit, 38 -- Bias current ON / off circuit (bias current control means), 39 [-- A bias current control circuit (bias current control means), 47 / -- A switching element, 48 / -- Current detection resistance, 53 / -- A malfunction detection circuit, 55 / -- Switching element.] -- A fail-safe circuit, 40 -- A solenoid coil, 42 -- A switching element, 46

[Translation done.]

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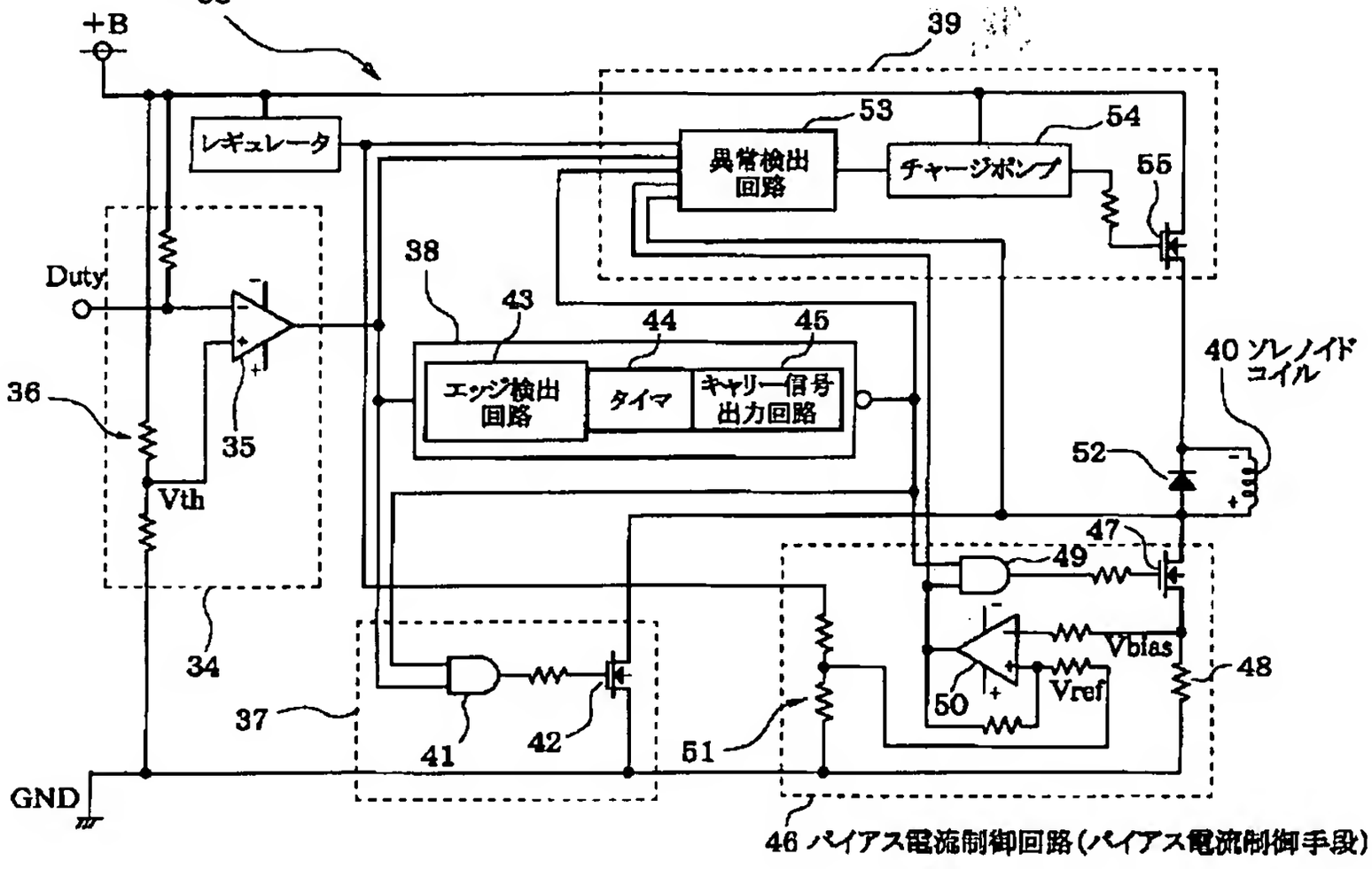
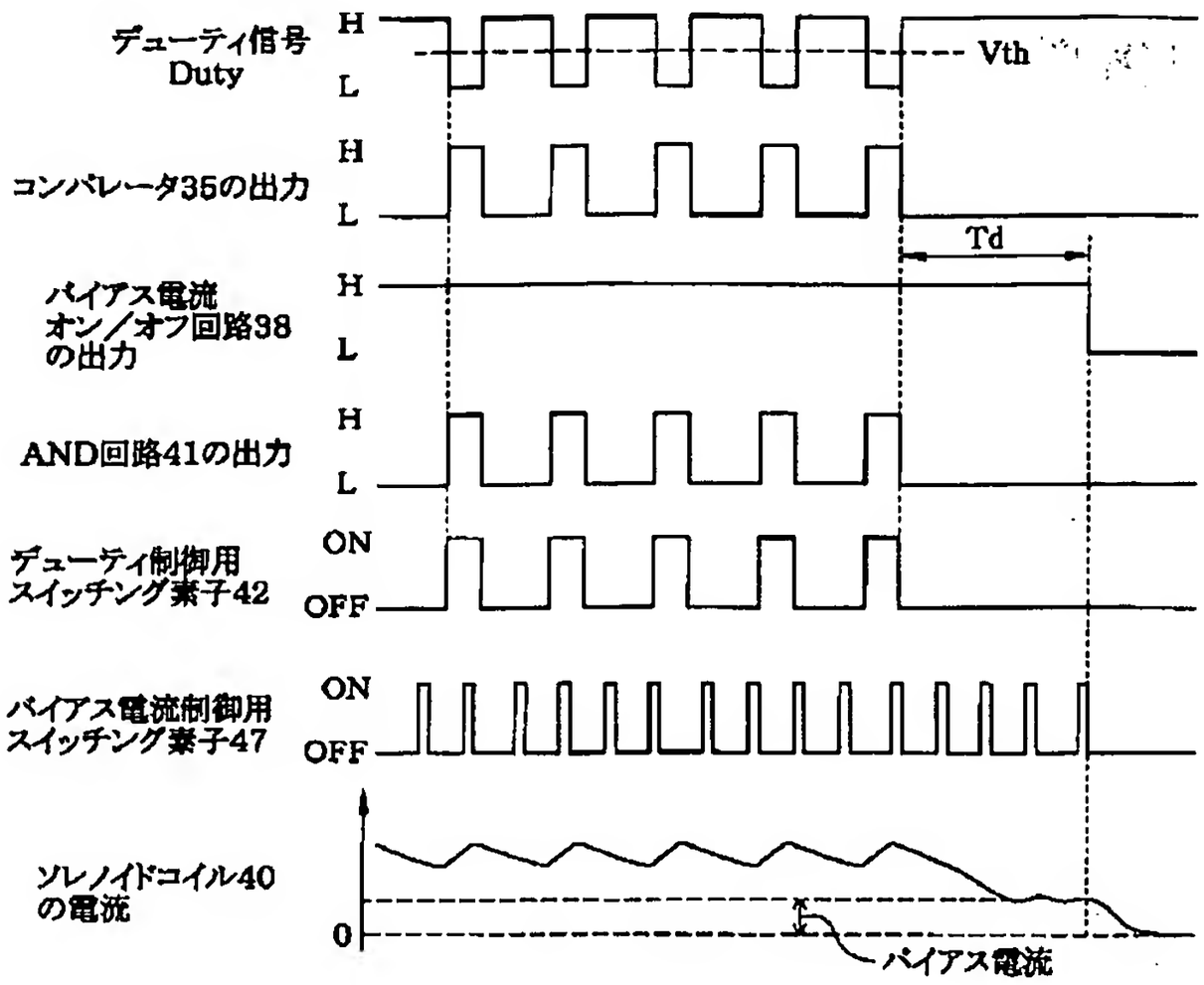
DRAWINGS

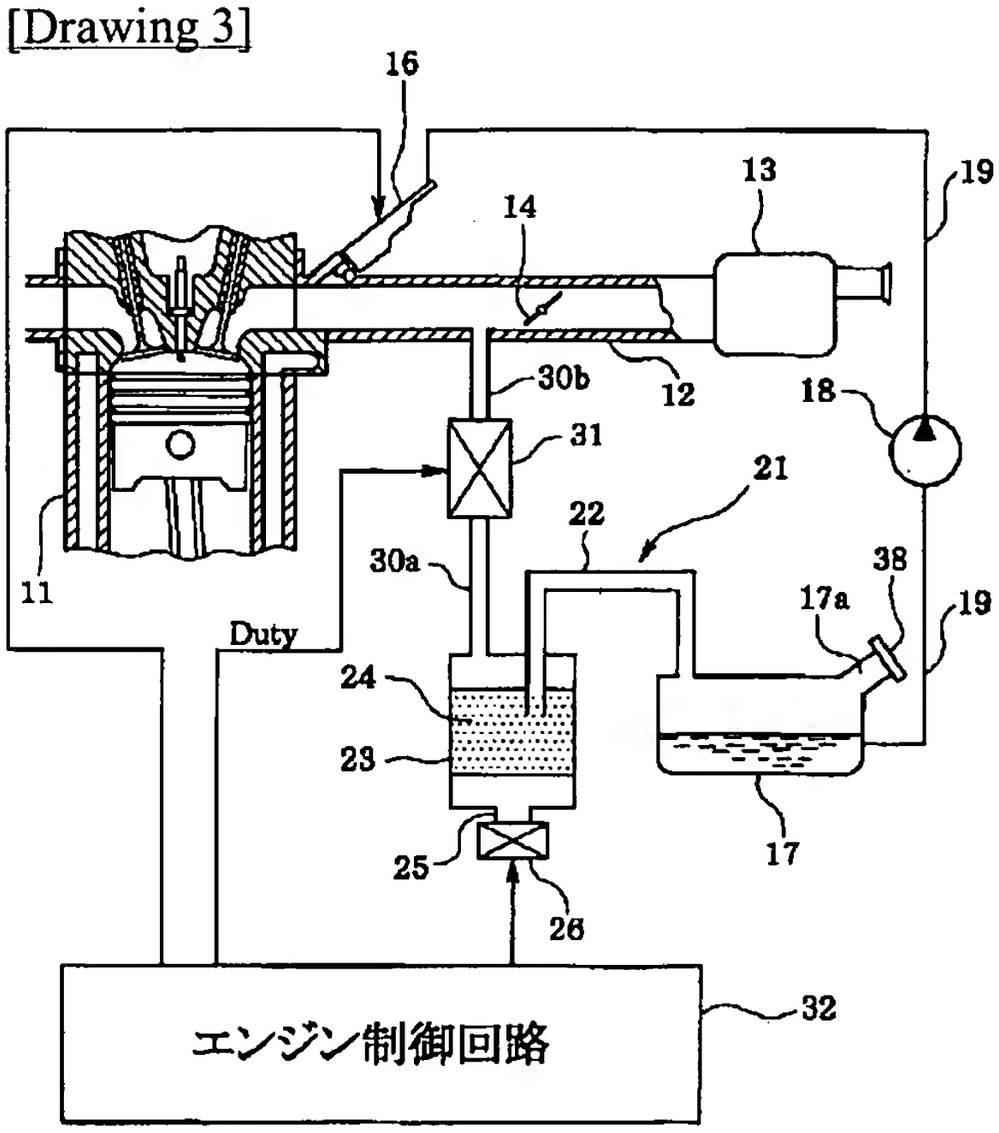
[Drawing 1]



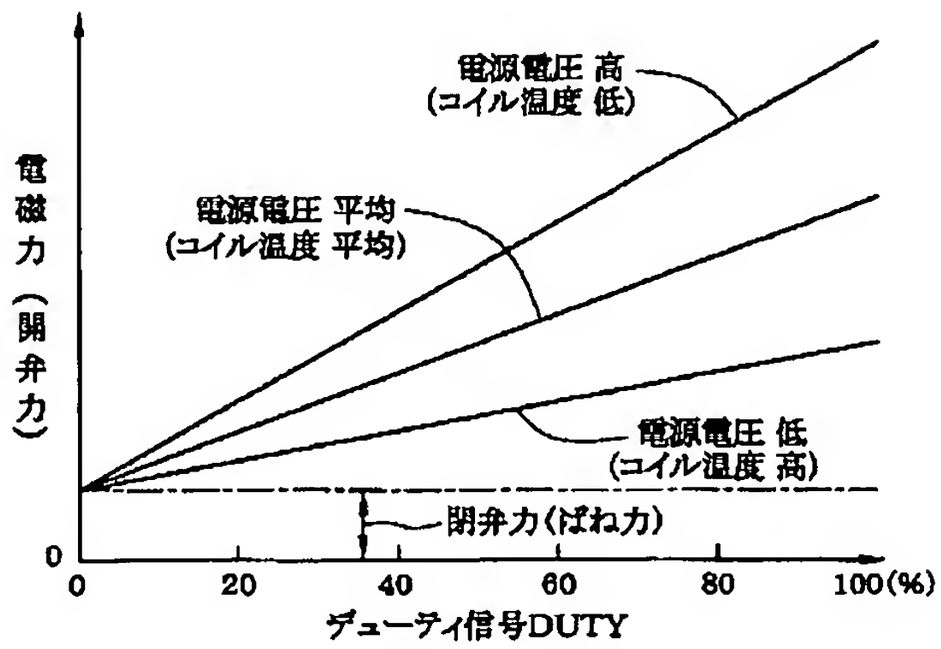
[Drawing 2]



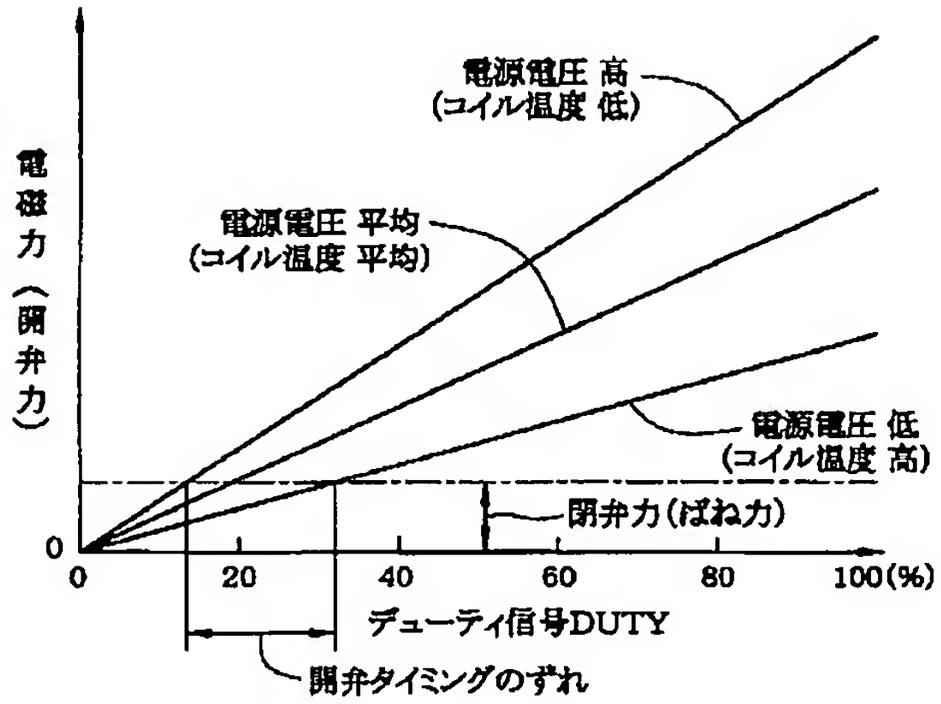
[Drawing 3]



[Drawing 4]



(a)本発明の実施形態



(b)従来のデューティ制御

[Translation done.]